DETERMINATION OF ENGINE PARAMETERS

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Annotation. *This article discusses the methods of improving the internal combustion engine by changing the indicators of injectors.*

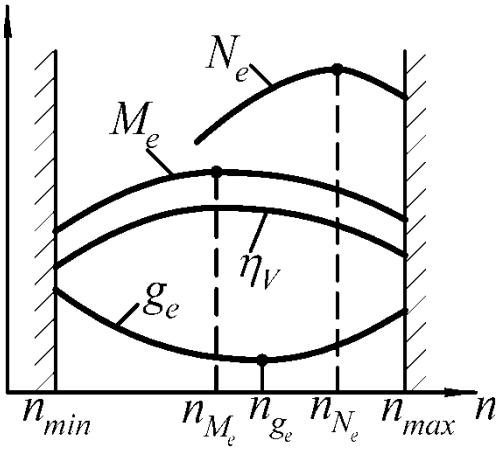
Keywords. *Internal combustion engine, injector, characteristic, torque, turnover*

Speed characteristics can be of two types:

The external speed characteristic is the dependence of the effective indicators of the internal combustion engine on the speed of the crankshaft with the throttle fully open.

Regulation n when obtaining a characteristic is performed by changing the load on the motor shaft.

Typical modes of internal combustion engine operation.



$n_{min} = 800...1000\ мин^{-1}$ – the minimum speed of the crankshaft at which the engine is running steadily at full load.

$n_{Ne} = 4000...6000\ мин^{-1}$ – the crankshaft speed corresponding to the maximum power is the rated frequency.

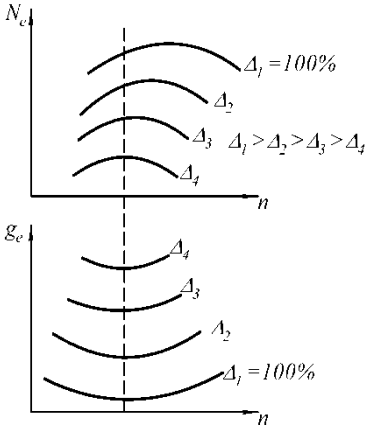
$n_{Me} = (0{,}4...0{,}6) \cdot n_{Ne}$ – the speed of the crankshaft, corresponding to the maximum torque.

$n_{ge} \approx n_{Me}$ – the crankshaft speed corresponding to the minimum specific fuel consumption.

$n_{max} = (1{,}05...1{,}10) \cdot n_{Ne}$ – maximum engine crankshaft speed.

The external speed characteristic is used to evaluate the maximum power capabilities of the engine in the entire operational frequency range.

$$N = M_{кр} \cdot \omega = M_{кр} \frac{2 \cdot \pi \cdot n}{60} = M_{кр} \frac{\pi \cdot n}{30}$$

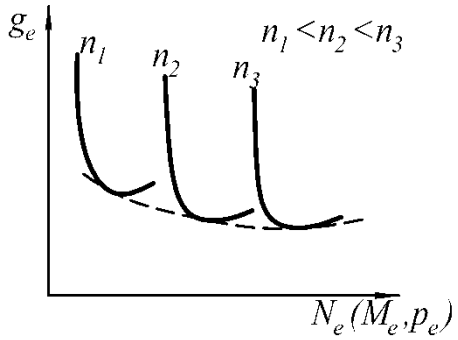


The partial speed characteristic is the dependence of the effective indicators of the internal combustion engine on the speed of the crankshaft at various constant throttle positions.

$\Delta \downarrow \rightarrow \eta_V \downarrow, \gamma_r \uparrow \rightarrow G_{пс} \downarrow \rightarrow N_e \downarrow, g_e \uparrow$

Load characteristics.

The load characteristic is the dependence of the effective engine performance on the load at constant engine crankshaft speed.



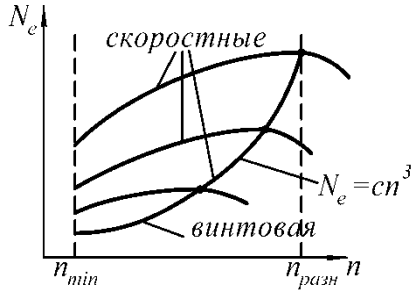
Upon receipt of the characteristic, the load is changed by the braking device.

Load characteristics can be built according to speed characteristics. To do this, use the parameters obtained at the same number of revolutions and located on the same vertical graph-speed characteristics.

The load characteristic is used to determine the most advantageous modes of operation of the internal combustion engine at a given speed.

Throttle characteristic (screw).

The throttle characteristic (screw) is the dependence of the change in the effective indicators of engine on the speed of the crankshaft at a constant load the internal combustion engine (for example: screw).



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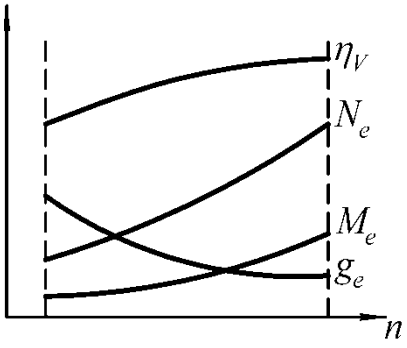
The frequency is regulated by changing the throttle position.

The screw characteristic is the geometric location of the points of intersection of the speed characteristics with the power curve of the screw.

$N_{вт}=N_e$ – screw power.

The screw characteristic is used to select a screw (or other device that creates a constant load) to enter the maximum power mode.



$$N_e = c \cdot n^3$$

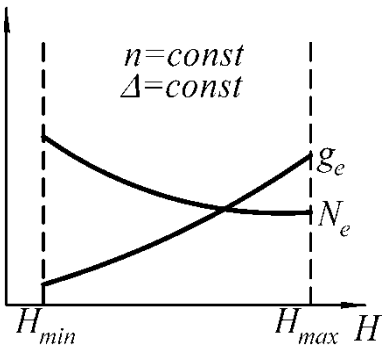
$$N_e = \frac{\pi \cdot n}{30} \cdot M_e$$

$$c \cdot n^3 = \frac{\pi \cdot n}{30} \cdot M_e$$

$$M_e = c_1 \cdot n^2$$

Altitude characteristics.

The altitude characteristic is the dependence of the effective indicators of the internal combustion engine on the flight altitude at a constant engine crankshaft speed, and with the throttle fully open.



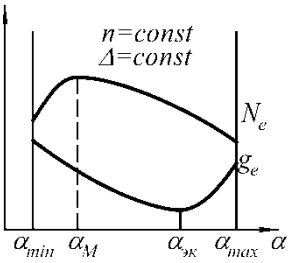
H – altitude above sea level.

$H \uparrow \rightarrow p_н, T_н \downarrow \rightarrow \eta_V \downarrow, \rho_k \downarrow \rightarrow N_e \downarrow, g_e \uparrow$

The altitude characteristic is used to assess the possibilities of using the engine on an aircraft (vehicle) with specified technical requirements.

To ensure the altitude of the engine, it is necessary to apply supercharging.

Adjustment characteristics. Characteristics of the composition of the mixture.



The characteristic of the mixture composition is the dependence of the engine performance on the excess air coefficient at a constant engine crankshaft speed, and when the throttle valve is fully opened (the characteristic is obtained experimentally).

The composition of the mixture changes with fuel consumption. The constant speed of the crankshaft is ensured by changing the load on the engine shaft.

$\alpha_{min} = 0{,}6$; $\alpha_{max} = 1{,}3$;

$\alpha_M = 0{,}8...0{,}9$; $\alpha_{эк} = 1{,}05...1{,}10$

The characteristic of the composition of the mixture is used to adjust (adjust) the fuel system of the engine according to the operating modes.

Features of the parameters of the DAEWOO Matiz car.

Basic parameters

As noted above, throughout the almost 20-year history of Daewoo Matiz, the technical characteristics of the car have changed slightly. A significant breakthrough took place in the early 2000s, when a modification with a liter engine entered the market.

Matiz, which was produced until 2015, was equipped with a 1-liter power unit. This engine has the best technical characteristics: the maximum power of the installation reaches 64 hp. However, there are no significant differences in dynamics and fuel efficiency indicators depending on the type of engine. So, on average, the car consumes 5.5-7 liters of fuel on the highway, and in the city — up to 8. On which work was carried out.

Testing part

Performance

Brand	Daewoo
Model	Matiz
Generation	Matiz II
Engine	1.0 i (64 Hp)
Doors	5
Power	64 HPW
Maximum speed	152 km/h
Acceleration from standstill to 100 kmh	15.3 sec
Fuel tank volume	38 Liters
Year of putting into production	2000 year
Year of stopping production	2015 year
Coupe type	Hatchback
Seats	4

Length	3495 MM
Width	1495 MM
Height	1485 MM
Wheelbase	2340 MM
Front track	1315 MM
Rear track	1280
Clearance	150 MM
Fuel consumption (economy) - urban	8.2 Liters/100 km
Fuel consumption (economy) - extra urban	5.3 Liters/100 km
Fuel consumption (economy) - combined	6.4 Liters/100 km
Weight	826 kg.
Max weight	1230 kg.
Maximum volume of Luggage	830 Liters
Minimum volume of Luggage	145 Liters
Emission standard	

Engine

Position of engine	Front, transversely
Volume of engine	995 cm3
Max power in	5400 rpm
Torque	87/4200 Nm
Fuel System	Multi-point injection
Turbine	
Position of cylinders	Inline
Number of cylinders	4
Diameter of cylinders	68.5 MM
Stroke in the cylinder	67.5 MM
Compression ratio	9.3
Number of valves per cylinder	2
Fuel Type	Petrol (Gasoline) A-92
Model Engine	

Brakes

Wheel Drive	Front
ABS	Yes
Steering type	Steering rack
Front brakes	Disc
Rear brakes	Drum
Valvetrain	-

Tire size	155/65 R13

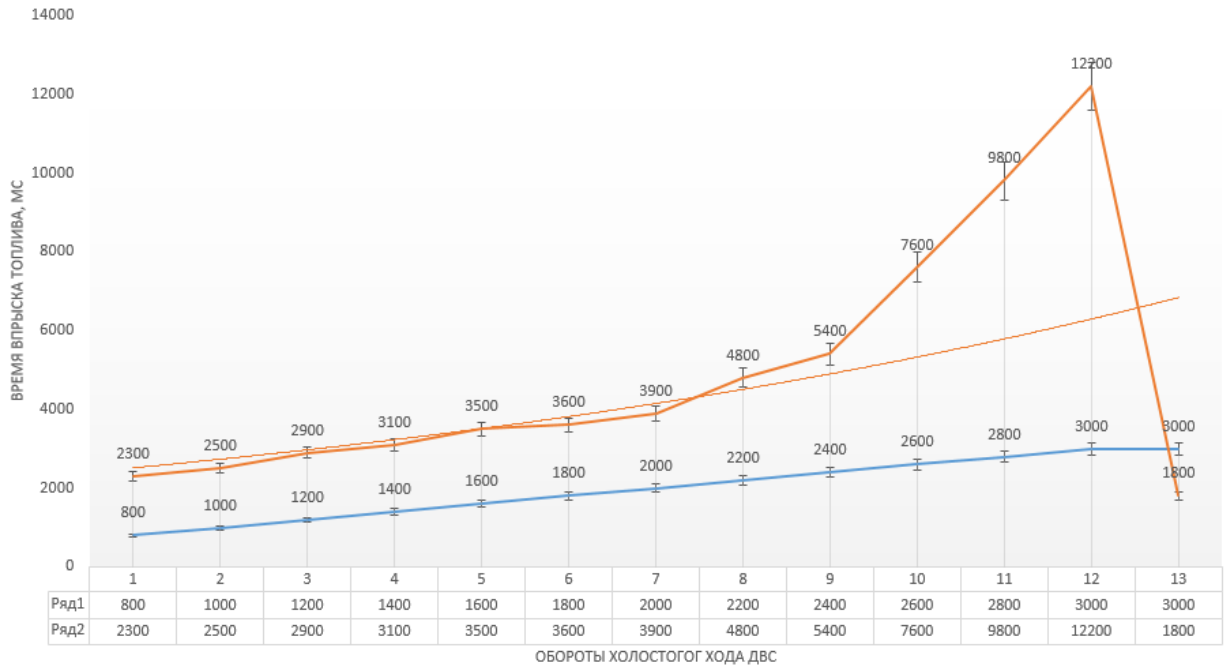
Wheel rims size	
Number of Gear (mechanical Gearbox)	5
Minimum turning circle (turning diameter)	9 meter
Power steering	
Transmission	
Front suspension	The depreciated rack
Rear suspension	Helical spring
Number of Gear (automatic Gearbox)	-

When performing engine diagnostics, the fuel consumption value is measured at an engine temperature above 80 ° C. The value of the relative fuel consumption at idle without load can be increased for three main reasons: increased engine load, low performance of the fuel supply system or engine control system malfunctions.

1. The load on the engine may increase due to the inclusion of external power take-off (power steering, air conditioning compressor, electricity consumers ...) or due to increased internal losses due to wear of the engine mechanics.

2. The performance of the fuel supply system may decrease due to contamination of the fuel injectors, or due to a decrease in pressure in the fuel rail due to wear of the fuel pump, contamination of the fuel filter or intake grid, or due to a malfunction of the fuel pressure regulator.

3. In the event of a malfunction of the engine control system causing violations of the composition of the fuel-air mixture (malfunction of the lambda probe, engine temperature sensor, air flow sensor, throttle position sensor ... or their circuits), the combustion efficiency of such a mixture is reduced. In this case, for example, to maintain the specified idle speed, a larger amount of the mixture is already needed. For this reason, the engine control system opens the idle valve slightly and, accordingly, increases the amount of fuel supplied, which leads to an increase in the value of relative fuel consumption.



Fuel injection schedule when changing revolutions on the stand

Fig. 1. Ultrasonic cleaning of injectors.

Figure 1 shows ultrasonic cleaning of the nozzles is a collapsible cleaning method when the parts are removed and loaded into a bath with a cleaning liquid. In this bath, ultrasonic waves act on the elements, which trigger the cavitation process in the working fluid and remove impurities.

When the engine is idling, the actual fuel consumption is minimal, and for most modern engines is ~2% of the maximum. The fuel consumption measured as a percentage of the maximum possible for a given engine can be called "relative consumption. That is, with an accurate calculation, the tests show that 1,199 grams of AI-80 fuel was spent during one hour of engine operation in idle mode.

Fig. 2. Nozzle cleaning equipment.

Figure 2 shows the equipment for cleaning the injectors where you can calculate the fuel consumption at idle. The first nozzle of the engine injected fuel in the amount of 10 ml at an engine speed of 800 rpm, fuel injection time of 3.8 ms, fuel ramp pressure of 4 bar and equipment usage time of 120 seconds.

When the engine is running in maximum load mode at maximum rpm, the actual fuel consumption is the maximum possible for this engine and it can be taken as 100%. If you view the voltage waveform of the injector control signal when the engine is running in this mode, you can see that the fuel injectors are constantly open.

Below, for example, is a table of measured values of relative fuel consumption for some cars when the engine is idling without load (the values of relative fuel consumption indicated in the table are not nominal).

Таблица 1.

Модель	Объём двигателя, л	Тип впрыска	Относительный расход топлива, %	Температура двигателя, °С	Режим работы двигателя
AUDI A6 4,2i	4,2	Последовательный	1,76	> 80 °С	Холостой ход
Toyota Carina E 1,8i	1,8	Последовательный	2,07	> 80 °С	Холостой ход
GAZ 3110 2,3i	2,3	Последовательный	3,27	> 80 °С	Холостой ход
DAEWOO LANOS 1,5i	1,5	Попарно-параллельный	2,05	> 80 °С	Холостой ход
DAEWOO LANOS 1,5i	1,5	Попарно-параллельный	2,69	> 80 °С	Холостой ход
Chevrolet NIVA 1,7i	1,7	Последовательный	3,23	> 80 °С	Холостой ход
Volkswagen Passat 1,8i	1,8	BOSCH Mono-Jetronic	4,29	> 80 °С	Холостой ход

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